fulfil the theoretical conditions, owing to errors introduced by refraction, aberration, centreing, orientation, and scale values. All these should be very small, however; and if the co-ordinates $(x_1\ y_1)$ are corrected by the above formulæ they should agree very nearly with $(x_2\ y_2)$—within a few seconds of arc, say 10″. Let their corrected values be called ξ_2 and η_2.

Then

$$x_2 = (1+a)\,\xi_2 + b\eta_2 + c$$
$$y_2 = d\xi_2 + (1+e)\,\eta_2 + f,$$

where $a\ b\ c\ d\ e\ f$ are very small quantities of the order $\frac{10''}{60'}$ or $\frac{1}{360}$, whose squares and products only introduce errors of the order

$$60' \times \left(\frac{1}{360}\right)^2 = 0''{\cdot}03,$$

and may therefore be neglected. Hence if we have a chain of plates each overlapping the next, and if we first correct the co-ordinates of one by the theoretical expressions which should make them agree with those of the next, the differences between the co-ordinates of a star $x_1 - x_2$, $y_1 - y_2$ will be linear functions of x and y with very small coefficients, say

$$x_1 - x_2 = a_{12}x_1 + b_{12}y_1 + c_{12}$$
$$y_1 - y_2 = d_{12}x_1 + e_{12}y_1 + f_{12},$$

and it is easily seen that

$$a_{1n} = a_{12} + a_{23} + \ldots + a_{\overline{n-1}\,.\,n},$$

and similarly for the other coefficients. Any system of plates which returns to the same plate thus gives us 6 equations between the experimentally determined coefficients of relation between each two.

Greenwich Mean Times of Superior and Inferior Geocentric Conjunctions of Jupiter's Satellite Callisto from 1894 *January to* 1895 *February.*

(*Communicated by the Superintendent of the Nautical Almanac.*)

The following times of geocentric conjunction of *Callisto* are in continuation of those published in *Monthly Notices*, vol. lii. p. 597, and are communicated to the Society with the view of drawing the attention of observers to the desirability of securing determinations of the positions of this satellite during the period

in which no observations of eclipses, occultations, or transits are possible.

On account of the interest and importance attaching to the first eclipses of a series, the times of superior heliocentric conjunctions of *Callisto*, occurring in 1894 December, are also given below. Assuming the accuracy of the tables, the first eclipse occurs on 1895 January 17; but it is quite possible that, owing to error in the tabular latitudes, there may be an eclipse of the satellite at one or both of the preceding conjunctions. And observers ought to be on the watch, on both these occasions, some considerable time before and after the predicted time of conjunction. The times of the corresponding inferior heliocentric conjunctions are also given, so as to enable observers to look out for the possible appearance of the shadow of the satellite on the disc on these occasions.

At the inferior heliocentric conjunction of *Callisto* on 1895 January 8, the shadow of the satellite ought, according to the tables, to fall on the disc of *Jupiter*. This first transit of shadow of the series was accidentally omitted from the *Nautical Almanac* for 1895. The following are the tabular times of ingress and egress of the shadow:—

Ingress: 1895 January $8^d\ 16^h\ 55^m$.
Egress: 1895 January $8^d\ 17^h\ 18^m$.

Superior Geocentric Conjunctions.

1894.	d	h	m	1894.	d	h	m
Jan.	12	22	46·9	Aug.	2	21	30·3
	29	15	45·4		19	17	30·1
Feb.	15	9	44·7	Sept.	5	12	57·2
Mar.	4	4	37·3		22	7	42·2
	21	0	12·9	Oct.	9	1	35·7
Apr.	6	20	20·8		25	18	30·2
	23	16	51·9	Nov.	11	10	22·6
May	10	13	39·3		28	1	18·4
	27	10	34·3	Dec.	14	15	32·7
June	13	7	31·2		31	5	33·9
	30	4	24·0	1895. Jan.	16	19	52·1
July	17	1	5·6	Feb.	2	10	53·8

Inferior Geocentric Conjunctions.

1894.	d	h	m	1894.	d	h	m
Jan.	4	16	2·4	July	25	12	2·5
	21	8	26·4	Aug.	11	8	12·1
Feb.	7	1	52·9		28	3	53·2
	23	20	17·0	Sept.	13	22	56·8
Mar.	12	15	28·7		30	17	13·3
	29	11	18·0	Oct.	17	10	34·8
Apr.	15	7	35·6	Nov.	3	2	55·7
May	2	4	12·2		19	18	17·0
	19	1	1·1	Dec.	6	8	49·7
June	4	21	54·7		22	22	54·7
	21	18	46·9	1895. Jan.	8	13	1·6
July	8	15	31·6		25	3	49·2
				Feb.	10	19	7·8

Superior Heliocentric Conjunctions.

1894.	d	h	m	1894.	d	h	m
Dec.	14	13	34·3	Dec.	31	7	43·2

Inferior Heliocentric Conjunctions.

1894.	d	h	m	1895.	d	h	m
Dec.	22	23	0·1	Jan.	8	17	6·3

Nautical Almanac Office:
1893 *November* 8.

Observed Conjunctions of Satellite IV. with Jupiter.

By the Rev. A. Freeman, M.A.

Date.	Observed δ.	Predicted δ.	P−O.	Power.
1892.	h m	h m	m	
(1) Nov. 3	10 6·25	10 18·5	12·25	116
1893.				
(2) Feb. 20	6 16·1	6 22·0	5·9	165
(3) Aug. 24	13 27·75	13 37·9	10·15	80
(4) Oct. 13	15 9·2	15 12·7	3·5	116
(5) Oct. 30	8 9·5 (W)	8 17·5	8·0	116

By a conjunction is meant a position of the satellite upon the least apparent diameter of the planet, produced beyond the disc. In one case, marked (W), the position observed was upon the tangent to 4's disc at the west end of his equator; in this case 2 hours 25 minutes is assumed to be the interval since conjunction with the polar axis. Usually an equatorial refractor with $6\frac{1}{2}$ inches aperture was employed, except on August 24, when a refractor of 3 inches aperture was used. The predictions refer to Dr. Downing's list of conjunctions in *Monthly Notices*, vol. lii. p. 597. The following distances are mere estimates. Having no clock-work I made no attempt to measure them with the micrometer. Observations on September 10, September 18, October 5, and November 7, 1893, were impeded by cloud:—

(1) From centre of IV. to north pole of 4 was one-third of polar radius of 4.
(2) The N. limb of IV. separated from south pole of 4 by a diameter of IV.'s disc.
(3) The N. limb of IV. separated from south pole of 4 by one-fourth of polar radius of 4.
(4) Centre of IV. is south of south pole of 4 by about one-third of polar radius of 4.
(5) Centre of IV. is south of south pole of 4 by about one-third of polar radius of 4.

The following observations have been supplied to me by Mr. A. Stanley Williams, of West Brighton. They were all made by himself with the aid of his reflecting telescope, having an aperture of $6\frac{1}{2}$ inches. I number them consecutively to my own, with which they may fitly be compared:—

Date.	Observed δ.	Predicted δ.	P−O.	Power.
1893.	h m	h m	m	
(6) Nov. 7	11 38·2	11 42·2	4·0	230
1890.				
(7) June 24	15 5·3	14 57·5	Shadow	150
(8) Aug. 30	8 32·4	8 44·5	12·1	230